(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 366 049 A2**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: 89119657.8

(51) Int. Cl.5: B21D 53/26 , B21D 22/16

(22) Date of filing: 23.10.89

(30) Priority: 24.10.88 JP 268559/88
24.10.88 JP 268560/88
13.04.89 JP 93339/89
26.08.89 JP 220067/89
26.08.89 JP 220068/89
26.08.89 JP 220069/89

(43) Date of publication of application:
02.05.90 Bulletin 90/18

(84) Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

(71) Applicant: Asahi Malleable Iron Co., Ltd.
Horinouchi 547-1 Kikugawa-cho
Ogasa-gun Shizuoka-ken, 439(JP)

(72) Inventor: Kato, Takashi
44-17, Narutaki
Kakegawa-shi Shizuoka-ken, 436(JP)
Inventor: Ochiai, Kimio
65, Kamo Kikukawa-cho
Ogasa-gun Shizuoka-ken, 439(JP)
Inventor: Kurebayashi, Masaru
855-6, Sakabe Haibara-cho
Haibara-gun Shizuoka-ken, 421-04(JP)

(74) Representative: Walter, Helmut
Aubingerstrasse 81
D-8000 München 60(DE)

(54) Spinning molding process, spinning molding apparatus, spinning molding raw material, spinning molding process of vehicle wheel, and spinning molding apparatus of vehicle wheel.

(57) A process for manufacturing a vehicle wheel has the steps of preparing a wheel raw material in which a rim raw material is integrally formed at a peripheral edge of a disk member, forming a rim portion by spinning the rim raw material while rotating the wheel material about the axis of the disk member, and thereafter heat processing such spin molded raw material and then cut machining the same. The process is characterized in that it further comprises the step of forming the thickness of only both edges of the rim portion greater than the finish dimension.

EP 0 366 049 A2

SPINNING MOLDING PROCESS, SPINNING MOLDING APPARATUS, SPINNING MOLDING RAW MATERIAL, SPINNING MOLDING PROCESS OF VEHICLE WHEEL, AND SPINNING MOLDING APPARATUS OF VEHICLE WHEEL

BACKGROUND OF THE INVENTION

[Field of the Invention]

This invention relates to a spinning molding process, a spinning molding apparatus, a spinning molding raw material, a spinning molding process of a vehicle wheel, and a spinning molding apparatus of a vehicle wheel.

[Brief description of the Prior Art]

As a process for manufacturing a vehicle wheel, there is a known process for an applying a heat treatment after the spinning molding is effected. In this manufacturing process, as the rim portion subjected to the spinning molding when a heat treatment is applied is readily deformed by heating, it is necessary to prevent the air leakage of a tire. Therefore, when the spinning molding is carried out, the rim portion 3, as shown in Fig. 23, is formed thicker than the finish dimension (shown by the one dotted chain lines in the drawings). And after subjected to the thermal treatment, such rim portion is cut into the finish dimension.

However, the above-mentioned conventional manufacturing process of vehicles has a first inconvenience in that as the thickness of the whole rim portion is formed greater than the finish dimension and the whole rim portion is cut after it is subjected to heat treatment, much time and labor are required for the cutting work and thus for the manufacturing work of the vehicle wheel, and the yield of product of the material is lowered.

Also, when a vehicle wheel is spinning molded in the prior art, it is performed in such a manner as that a raw material of a vehicle wheel is disposed on the periphery of a molding die (mandrel) and said wheel raw material is drawn along the molding die by a rotary pressing device while rotating this wheel raw material together with the molding die.

However, as the molding die (mandrel) is inherent in vehicle wheels, it is required to be exchanged with a separately prepared molding die (mandrel) when a vehicle wheel having different rim width is to be molded.

Therefore, it has a second inconvenience in that in order to spinning mold a vehicle wheel, several kinds of molding dies (mandrels) must be prepared and as a consequence, the manufacturing cost of the molding dies (mandrels) is increased and in addition, it takes much time and labor for maintaining the molding die s(mandrels).

Also, in the prior art, when the spinning molding is to be carried out, first, a raw material is cast and such cast raw material is spinning molded.

In this case, in the prior art, there were used, as a molding material , the so-called 4 C-material (for example, Cu: 0.006 wt.%, Mg: 0.33 wt.%, Fe: 0.12 wt.%, Mn: 0.006 wt. %, Ti: 0.115%, Sb: 0.112 wt. %, and remainder Al). And by casting this molding member and , a raw material is manufactured and this raw material is spinning molded.

However, as one, which is spinning molded after a raw material is cast using the conventional molding material, has a third inconvenience in that moldability is poor due to lack of expansion.

Also, in the prior art, for example, when a vehicle wheel W is to be spinning molded, a disk portion D and a cylindrical rim raw material 4, as shown in Fig. 24, are molded by forging or casting to obtain a wheel raw material 1. And by drawing this raw material 1, which is engaged on the outer periphery of a rim molding mandrel 12, in the direction as shown by the arrow through a rotary pressing device 2, a rim portion 31 is formed (Japanese Patent Early Laid-open Publication No. Sho 61-115640).

However, in such conventional spinning molding process as mentioned above, when a cylindrical raw material to be molded (cylindrical rim raw material) 3 is placed on the molding mandrel (rim molding mandrel) 12, this cylindrical raw material to be molded (cylindrical rim raw material) 3 is intimately contacted with a molding surface 126 of said molding mandrel (rim molding mandrel) 12.

Due to the foregoing arrangement, when such cylindrical raw material 3 as mentioned is drawn through the rotary pressing device 2, friction is generated between the cylindrical raw material 3 and the molding surface 126 of the mandrel 12. Therefore, it has a fourth inconvenience in that it takes much time and labor to draw the cylindrical raw material 3 along the projecting portion (rim flange molding portion) of the molding surface 126.

Also, in such conventional spinning molding process as mentioned, as the cylindrical raw material to be molded (cylindrical rim raw material) 3 becomes gradually thinner as it goes toward the peripheral edge portion thereof, it has a fifth inconvenience in that the thickness of a rising portion 311 is difficult to be formed great when the cylindrical raw material 3 is drawn by the rotary pressing device 2 along the projecting portion (rim

flange molding portion) of the molding surface 126.

Furthermore, in such conventional spinning molding process as mentioned above, as the thickness of the connecting portion between the cylindrical raw material to be molded (cylindrical rim raw material) 3 and a plate portion to be clamped (disk portion) D is great, it has a sixth incon venience in that a decaying part is readily generated on the connecting portion 315 when the raw material 1 is cast and thus, the strength of a spinning molded article is difficult to maintain.

Furthermore, in such conventional spinning molding process as mentioned above, when the cylindrical raw material to be molded (cylindrical rim raw material) 3 is placed on the molding mandrel (rim molding mandrel) 12, this cylindrical raw material to be molded (cylindrical rim raw material) 3 is intimately contacted to the molding surface 126 of the molding mandrel (rim molding mandrel) 12.

Due to the foregoing, friction is generated between the cylindrical raw material 3 and the molding surface 126 of the mandrel 12 when the cylindrical raw material 3 is drawn by the rotary pressing device 2. Therefore, it has a seventh inconvenience in that it takes much time and labor to draw the cylindrical raw material 3 along the molding surface 126.

Also, in the prior art, when a vehicle wheel is spinning molded, a wheel raw material is mounded on the molding mandrel and the wheel raw material is drawn by a pressing member along the molding surface of the mandrel while rotating the mandrel.

However, in such conventional spinning molding process as mentioned above, the connecting portion between a spoke portion of a vehicle wheel and a rim portion is necessarily great in view of necessity of providing a drawing gradient to the mandrel. Therefore, it has an eighth inconvenience in that the weight of such vehicle wheel easily becomes heavy.

Also, in the conventional spinning molding, a cast raw material to be molded is placed on the mandrel and the raw material to be molded is drawn into a predetermined shape along the mandrel while rotating the raw material to be molded together with the mandrel and pressing the same with a pressing spatula.

However, as such spinning molding process as mentioned above is a molding process which utilizes ductility of the cast raw material to be molded, it has a ninth inconvenience in that when such raw material to be molded is rapidly machined into a complicated shape, difficulty occurs in the raw material to be molded and cracks are readily taken place.

Also, in the spinning molding apparatus, the raw material to be molded is drawn by the pressing member along the molding surface of the mandrel while clamping the raw material to be molded between the mandrel and the tail stock and rotating the mandrel. In this case, as for a raw material to be molded having a not-flat clapping surface (tail stock side) of the raw material to be molded, it is designed such that the contact surface of the tail stock is also intimately contacted with the clamping surface. Accordingly, when the raw material to be molded is clamped by the tail stock, correct positioning must be obtained by rotating the tail stock so that each contact surface of the tail stock is tightly contacted with the clamping surface of the raw material to be molded.

However, in the conventional spinning molding process, as the tail stock and the mandrel can be independently rotated, when the raw material to be molded is to be clamped, a proper position (position where the contact surface of the tail stock can be tightly contacted with the clamping surface of the raw material to be molded) must be determined by rotating the tail stock after the raw material to be molded is set to the mandrel. Therefore, it has a tenth inconvenience in that when a spinning molding is effected, it takes much time and labor for the process for clamping the raw material to be molded.

Also, there is a case where it is required to show size, manufactured date, etc. on a spinning molded article such as, for example, a vehicle wheel.

In this case, in the prior art, the above-mentioned items are shown by suitable means (for example, stamping) after the raw material to be molded is subjected to spinning molding.

However, this way of showing the above-mentioned items on the vehicle wheel through separate procedure after spinning molding requires two steps of working processes. Therefore, it has an eleventh inconvenience in that the working efficiency of the spinning molding is necessarily lowered.

The problem to be solved by the present invention is to eliminate the above-mentioned inconveniences inherent in the prior art.

SUMMARY OF THE INVENTION

It is therefore a first object of the present invention to eliminate the first inconvenience.

And this object has been achieved by providing a process for manufacturing a vehicle wheel comprising the steps of preparing a wheel raw material in which a rim raw material is integrally formed at a peripheral edge of a disk member, forming a rim portion by spinning said rim raw material while rotating said wheel material about

the axis of said disk member, and thereafter heat processing such spin molded raw material and then cut machining the same, characterized in that said process further comprises the step of forming the thickness of only both edges of said rim portion greater than the finish dimension. The first object has also been achieved by providing a process for manufacturing a vehicle wheel as claimed in claim 1, wherein said both edges of said rim portion are a rim hump portion and a rim flange portion.

A second object of the present invention is to eliminate the second inconvenience.

And this second object has been achieved by providing a spin molding apparatus of a vehicle wheel comprising a molding die, on the periphery of which a wheel raw material is place, and a rotary pressing device separately prepared and adapted to draw said wheel raw material along said molding die while rotating said wheel raw material together with said molding die, characterized in that a drop center molding portion in said molding die is cut in the vertical direction through the axis thereof and an auxiliary molding die is disposed in the cutting plane.

A third object of the present invention is to eliminate the third inconvenience.

And this third object has been achieved by providing a spinning molding material containing Si: 3~ 6 weight percent and Mg: 0.2~ 0.5 weight percent.

A fourth object of the present invention is to eliminate the fourth inconvenience.

And this fourth inconvenience has been achieved by providing a spinning molding process comprising the steps of integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped, and spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape, characterized in that said process further comprises the step of forming a peripheral portion of said cylindrical raw material on the highest projecting portion of a molding surface in said molding mandrel when said cylindrical raw material is mounted on said molding mandrel.

A fifth object of the present invention is to eliminate the fifth inconvenience.

And this fifth object has been achieved by providing a spinning molding process comprising the steps of integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped, and spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape, characterized in that said process further comprises the step of forming the thickness of the peripheral edge portion in said cylindrical raw material to be molded greater than that of the remainder.

A sixth object of the present invention is to eliminate the sixth inconvenience.

And this sixth object has been achieved by providing a spinning molding process comprising the steps of integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped, and spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape, characterized in that said process further comprises the step of forming a peripheral groove-like twisted portion on an outer wall surface of a generally connecting portion between said cylindrical raw material to be molded and said plate portion to be clamped.

A seventh object of the present invention is to eliminate the seventh inconvenience.

And this seventh has been achieved by provided a spinning molding process comprising the steps of integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped, and spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape, characterized in that said process further comprises the step of forming a gap between said cylindrical raw material to be molded and said molding mandrel when said cylindrical raw material to be molded is mounted on said molding mandrel, said gap being formed such that it becomes gradually greater in width as it goes toward the peripheral edge thereof. The seventh object has also be achieved by proving a spinning molding process as claimed in claim 8, wherein an angle formed between said cylindrical raw material to be molded and the molding surface of said molding mandrel is about 5~ 30 degrees. The seventh object has also be achieved by providing a spinning molding material comprising a plate portion to be clamped, a cylindrical raw material to be molded integrally formed with the peripheral edge of said plate portion to be clamped, and a molding mandrel with the outer periphery of which said raw material to be molded is engaged when said raw material to be molded is spinning molded into a predetermined shape, characterized in that said cylindrical molding material to be molded is gradually dilated as it goes toward the peripheral edge thereof and the dilating angle is steppingly changed as it goes toward the peripheral edge thereof. The seventh object has also been achieved by providing a pinning molding material as claimed in claim 10, wherein said dilating angle of said cylindrical raw material to be molded becomes steppingly greater. The seventh object has also been achieved by providing a spinning

molding material as claimed in claim 10 or claim 11, wherein said dilating angle of said raw material to be molded is greater than the dilating angle of said molding surface.

An eighth object of the present invention is to eliminate the eighth inconvenience.

And this eighth object has been achieved by providing a spinning molding cylindrical raw material having a groove portion formed on the inner peripheral surface of a cylindrical body along the width direction thereof. The eighth object has also been achieved by providing a pinning molding process of a cylindrical body comprising the steps of fixing a spinning molding cylindrical raw material having a groove portion formed on the inner peripheral surface of said cylindrical body along the width direction thereof to the outer surface of a mandrel, rotating said cylindrical raw material by rotating said mandrel about the axis thereof, and drawing said cylindrical body along a molding surface of said mandrel while partly pressing the peripheral surface of said cylindrical body with a pressing device.

A ninth object of the present invention is to eliminate the ninth inconvenience.

And this ninth object has been achieved by providing a spinning molding apparatus comprising a mandrel on which a cast raw material to be molded is placed, heating means for heating said cast raw material to be molded which is being rotated in accordance with rotation of said mandrel, and a pressing spatula for pressing said rotating cast raw material to be molded so that said cast raw material to be molded is drawn along said mandrel in the meantime, characterized in that the components of said cast raw material to be molded are as follows;

Si; 5.0~ 9.0%, Mg; 0.15~ 0.4%, Ti≦ 0.2%, Fe≦ 0.3%, Al: remainder, or

Si≦ 0.2%, Mg; 2.5~ 5.5%, Ti≦ 0.2%, Mn≦ 0.6%, Al: remainder. The ninth object has also been achieved by providing a spinning molding apparatus as claimed in claim 15, wherein said cast raw material to be molded can be heated to about 230~ 400°C by said heating means. The ninth object has also been achieved by providing spinning molding apparatus of a vehicle wheel comprising a mandrel on which a cast raw material to be molded is placed, heating means for heating said cast raw material to be molded which is being rotated in accordance with rotation of said mandrel, and a pressing spatula for pressing said rotating cast raw material to be molded so that said cast raw material to be molded is drawn along said mandrel in the meantime, characterized in that the components of said cast raw material to be molded are as follows;

Si; 5.0~ 9.0%, Mg; 0.15~ 0.4%, Ti≦ 0.2%, Fe≦ 0.3%, Al: remainder, or

Si≦ 0.2%, Mg; 2.5~ 5.5%, Ti≦ 0.2%, Mn≦ 0.6%, Al: remainder. The ninth object has also been achieved by providing a spinning molding apparatus of a vehicle wheel as claimed in claim 17, wherein said cast raw material to be molded can be heated to about 230~ 400°C by said heating means.

A tenth object of the present invention is to eliminate the tenth inconvenience.

And this tenth object has been achieved by providing a spinning molding apparatus comprising a base, a molding mandrel and a tail stock arranged on said base such that axes of said mandrel and tail stock are aligned, said mandrel and tail stock being reciprocally movable along said axes and being rotatable about said axes, and a pressing member for drawing said raw material to be molded clamped by said mandrel and said tail stock along a molding surface of said mandrel into predetermined shape while rotating said mandrel, characterized in that said spinning molding apparatus further comprises a retaining rod reciprocally movably disposed on said base for movement with respect to the tail stock direction; and a retaining portion mounted on said tail stock such that said tail stock can be retained by said retaining portion.

An eleventh object of the present invention is to eliminate the eleventh inconvenience.

And the eleventh object has been achieved by providing a spinning molding apparatus comprising a spinning molding mandrel having a raw material to be molded placed thereon, and a pressing member for pressing said raw material to be molded along a molding surface of said mandrel while rotating said mandrel about the axis thereof, so that said raw material to be molded is molded into a predetermined shape, characterized in that a displaying irregular portion is formed on said molding surface of said mandrel.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing the embodiment of claims 1 and 2;

Fig. 2 is a vertical sectional view of the embodiment of claim 3;

Fig. 3 is a graph showing moldability of claim 4;

Fig. 4 is likewise a graph showing expansion thereof;

Fig. 5 is a sectional view showing the embodiment of the process of claims 5 through 7 in which a raw material of a vehicle wheel is placed on a mandrel;

Fig. 6 is a sectional view of the raw material of a vehicle wheel placed on a mandrel of claims 8

through 12;

Figs. 7 through 12 show the embodiment of claim 13 and 14, wherein;

Fig. 7 is a perspective view showing the outer surface side of a raw material of a vehicle wheel;

Fig. 8 is likewise a perspective view showing the reverse surface side thereof;

Fig. 9 is a rear view thereof;

Fig. 10 is a sectional view taken on line X-X of Fig. 9;

Fig. 11 is a sectional view showing a raw material of a vehicle wheel placed on a mandrel;

Fig. 12 is a sectional view of a final product of a vehicle wheel;

Fig. 13 is a sectional view of the embodiment of claims 15 through 18;

Figs. 14 through 19 are schematic views showing the steps of the embodiment of claim 19;

Figs. 20 through 22 show the embodiment of claim 20, wherein;

Fig. 20 is a sectional view;

Fig. 21 is an enlarged view of the portion shown by XXI of Fig. 20;

Fig. 22 is a perspective view of a molded vehicle wheel; and

Figs. 23 and 24 are sectional views of the prior art.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The embodiment of claims 1 and 2 will now be described with reference to Fig. 1.

In Fig. 1, the numerals 11, 12 denote a pair of mandrels which are rotatable (see the arrow) about the axis thereof. Similarly, the numeral 2 denotes a rotary pressing device forming a pair with the mandrels 11, 12 is used when an intermediate raw material 3 of a vehicle wheel as will be described hereinafter is spinning molded. The numeral 3 denotes the intermediate raw material of a vehicle wheel which is sandwiched by the mandrels 11, 12. This vehicle wheel intermediate raw material 3 is spinning molded by sandwiching a raw material of a wheel (not shown) between the mandrels 11, 12 and drawn, while rotating, along the outer surfaces of the mandrels 11, 12 by the rotary pressing device 2. When the vehicle wheel intermediate raw material 3 is molded, the thickness of a rim flange portion 311 and the thickness of a rim hump portion 312 in a rim portion 31 are formed greater than the finish dimension (shown by one dotted chain lines in Fig. 1). And after removed from the mandrels 11, 12, the vehicle wheel intermediate raw material 3 is heated and then the thickness of the rim flange portion 311 and the thickness of the rim hump portion 312 are finished to the finish dimension to obtain a vehicle wheel.

As the manufacturing process of a vehicle wheel of claim 1 is constituted in the manner as mentioned above, when the rim portion is molded through spinning molding, the thickness of only the peripheral edge portion of the rim portion is formed greater than the finish dimension and the cutting treatment after heat treatment is applied only to the peripheral edge portion. Accordingly, a portion requiring a cutting treatment in the succeeding processes becomes less.

As a consequence, if the manufacturing process of a vehicle wheel is employed, it does not take much time and labor for the cutting treatment after heat treatment which will be performed after the spinning molding, the vehicle wheel can be manufactured with ease and the yield of material is improved.

Next, the embodiment of claim 3 will be described with reference to Fig. 2.

In Fig. 2, the numeral 2 denotes a spinning molding mandrel (corresponding to the "molding die" of the present invention), which is rotatable about the axis 127 thereof. In this mandrel 12, the numeral 126 denotes a reverse rim molding portion, and 13 denotes a drop center molding portion. By the way, this mandrel 12 is cut in the vertical direction with respect to the axis at the drop center molding portion 13 and split into an outer portion 121 and an inner portion 122. Also, the numeral 4 denotes a molding auxiliary die which is removably sandwiched between the outer portion 121 and the inner portion 122 in the mandrel 12. The peripheral surface of this molding auxiliary die 4 is flushed with the molding portion of the drop center 13 of the mandrel 12 and acts as a drop center molding portion when spinning molding. The numeral 41 denotes a fixing bolt which is adapted to fix the molding auxiliary die 4 to the outer portion 121 and inner portion 122 in the mandrel 12.

A vehicle wheel is molded in such constructed spinning molding die apparatus as mentioned above in the following manner.

First, a vehicle wheel raw material (not shown) is placed on the mandrel 12 as such that the raw material is engaged with the outer surface of the mandrel 12 and clamped by the auxiliary mandrel 11. And while rotating this wheel raw material about the axis, it may simply be withdrawn by the rotary pressing device 4 in the direction as shown by the ar row. As a result, a vehicle wheel as shown in Fig. 2 is formed. In this case, the peripheral surface of the molding auxiliary die 4 forms a part of the drop center of the vehicle wheel W.

As the spinning molding device of a vehicle wheel of claim 3 is constructed in the manner as mentioned above, the width of the rim of the vehicle wheel to be spinning molded is adjustable by

changing the width of this molding auxiliary die.

Accordingly, if several kinds of molding auxiliary dies are prepared beforehand and properly selected in accordance with necessity, vehicle wheels having different rim widths can be spinning molded in the present form of a molding die.

Therefore, if the spinning molding die apparatus of a vehicle wheel according to the present invention is employed, it is no more required to prepare several kinds of molding dies (mandrels) in order to spinning molding vehicle wheels which have different rim widths. As a consequence, the manufacturing cost of the molding die (mandrel) can be decreased and the maintenance of the molding die (mandrel) becomes comparatively easy.

Next, in the spinning molding material of claim 4,

(1) the content of Si is limited to 3~ 6 wt.% because if it is 3 wt.% or less, the hot melt fluidity is lowered during casting and an ingot piping is easily generated, and also, as shown in Figs. 3 and 4, if the content of Si is 6 wt.% or more, the expanding property is lowered although a sufficient strength of the vehicle wheel can be ensured,

(2) the content of Mg is limited to 0.2~ 0.5 wt.% because if it is 0.2 wt.% or less, the tensile force is lowered as shown in Fig. 4, and also, if it is 0.5 wt.% or more, the expanding property of the vehicle wheel is lowered.

A vehicle wheel raw material was cast from a spinning molding low Si material (Cu: 0.003 wt.%, Si: 4.6 wt. %, Mg. 0.36 wt.%, Fe: 0.12 wt.%, Mn: 0.004 wt.%, Ti: 0.10 wt.%, Sb: 0.078 wt.%, and remainder: Al), and this wheel raw material was spinning molded to manufacture a vehicle wheel. And the test results of the expansion in this vehicle wheel are shown in Figs. 1 and 2. The test was carried out in such a manner as that a dish-shaped (thickness: 10mm) test piece was made and the dish-shaped test piece was molded by a spinning machine.

[Comparison Example (Prior Art)]

A vehicle wheel raw material was cast from a spinning molding 4C material (Cu: 0.006 wt.%, Si: 6.9 wt. %, Mg. 0.33 wt.%, Fe: 0.12 wt.%, Mn: 0.006 wt.%, Ti: 0.115 wt.%, Sb: 0.112 wt.%, and remainder: Al), and this wheel raw material was spinning molded to manufacture a vehicle wheel. And the test results of the expansion in this vehicle wheel are shown in Figs. 3 and 4. The test was carried out in the same pro cedure as the embodiment.

As the spinning molding material of claim 4 is constructed in the manner as mentioned above, if the spinning raw material is cast and this raw material is molded, the moldability is goods because the expansion is excellent as shown in Figs. 3 and 4.

Next, the embodiment of claims 5 through 7 will be described with reference to Fig. 5.

In Fig. 5, the reference character D denotes a disk portion (corresponding to the "plate portion to be clamped" in claims 5 through 7) of the vehicle wheel raw material 1, and the numeral 5 denotes an outer side rim portion integrally formed on the outer peripheral edge portion of this disk portion D by forging or casting. The numeral 3 denotes a reversed side cylindrical rim raw material (corresponding to the "cylindrical raw material to be molded" of claims 5 through 7) which is integrally formed on the reversed side peripheral edge portion of the disk portion D by forging or casting as in the case with the outer side rim portion 5. This reversed side cylindrical rim raw material 3 is made into a reversed side rim portion 31 the spinning molding, and the thickness A of the peripheral edge portion 32 is greater than the thickness B of the root and trunk portion. Also, the numeral 316 denotes a twist which is formed on the outer wall surface at the connecting portion between the reversed side cylindrical raw material 3 and the disk portion D. This twist 316 extends like a groove over the peripheral surface of the reversed side cylindrical raw material 3.

Such constructed vehicle wheel raw material 1 is placed on the mandrel 12. In this case, a gap 5 is formed between the reversed side cylindrical raw material 3 and the rim molding surface 123 of the mandrel 23. The angle θ formed between the reversed side cylindrical raw material 3 and the rim molding surface 123 is preferably about 8 degrees. Also, a front end portion 32 of the cylindrical rim raw material 3 is more projected (in the radial direction of the disk portion D) than the rim flange molding surface (corresponding to the "most projected portion" of claims 5 through 7) 124 of the mandrel 12.

And by rotating the mandrel 12 about the axis 125 and drawing the reversed side cylindrical raw material 3 in the arrow direction by the rotary pressing device 2, the cylindrical raw material 3 is gradually deformed into the state as shown by the imaginary line (from the right-hand side to the left-hand side) to form the reversed side rim 31 and thus the vehicle wheel W.

The numeral 11 denotes a pressing plate for clamp fixing the wheel raw material 1 to the mandrel 4.

As the spinning molding process of claim 5 is constituted in the manner as mentioned above, when the cylindri cal raw material to be molded along the molding surface of the mandrel, the cylindrical raw material to be molded easily gets used

to the molding surface along its projecting portion.

Thus, if this spinning molding process is used, the cylindrical raw material to be molded can be easily molded along the projecting molding surface (of the mandrel).

Also, as the spinning molding process of claim 6 is constituted in the manher as mentioned above, when the cylindrical raw material to be molded is drawn along the projected part of the molding surface of the mandrel, there can be worked with a sufficient raw material.

Therefore, if this spinning molding process is used, when the cylindrical raw material to be molded is drawn along the projected part of the molding surface, the thickness of the rising part can be maintained to a predetermined degree with ease.

Also, as the spinning molding process of claim 7 is constituted in the manner as mentioned above, the connecting portion between the cylindrical raw material to be molded and the plate portion to be clamped can be made comparatively thin. Consequently, when such raw material as mentioned is cast, a decayed part is not easily occurred at the connecting portion. As a result, the strength of the spinning molded product can be maintained with ease.

Next, the embodiment of claims 8 and 9 will be described with reference to Fig. 6.

The vehicle wheel raw material 1 of claim 5 is placed on the mandrel 12. In this case, a gap S is formed between the reversed side cylindrical raw material 3 and the rim molding surface 123 of this mandrel 12 in such a manner as that the gap S is gradually dilated as it goes toward the front end portion of the reversed side cylindrical raw material 3. The angle θ formed between reversed side cylindrical raw material 3 and the rim molding surface 123 is preferably about 5 to 30 degrees. The reason is that if the angle θ is less than 5 degrees, when the rotary pressing device (roller) 2 as will be described hereinafter is poked against the reversed side cylindrical raw material 3, the bottom surface on the front end side from the poked portion in the reversed side cylindrical raw material 3 is contacted with the molding surface of the mandrel 12. As a consequence, the drawing amount per each time is limited, it is required to repeat such drawing several times in order to achieve this object.

On the other hand, if the angle θ exceeds 30 degrees, when the rotary pressing device (roller) 2 as will be described hereinafter is poked against the reversed side cylindrical raw material 3, the contact area between the reversed side cylindrical raw material 3 and the rotary pressing device (roller) 2 becomes too large and as a result, there is such a fear as that the reversed side cylindrical raw material 3 is broken in the middle.

Also, the front end portion 32 of the cylindrical rim raw material 3 is larger in diameter in the radial direction of the disk portion D than the rim flange molding surface of the mandrel 12.

Also, as the spinning molding process of claim 8 is constituted in the manner as mentioned above, when the cylindrical raw material to be molded is drawn along the molding surface of the mandrel, such cylindrical raw material to be molded gets readily used to such molding surface.

Accordingly, if this spinning molding process is used, it is easy to spinning mold the cylindrical raw material to be molded into a predetermined shape (for example, vehicle wheel) along molding mandrel.

If the angle formed between the cylindrical raw material to be molded and the molding surface of the molding mandrel is set to 3– 30 degrees as in the spinning molding process of claim 9, working efficiency of the spinning molding is greatly improved.

Next, the embodiment of claims 10 through 12 will be described with reference to Fig. 6.

In Fig. 6, the reversed side cylindrical raw material 3 is formed into a reversed side rim portion 31 by spinning molding and is gradually dilated as it goes toward the front edge thereof. And the dilating angles α_1 α_2 and α_3 become steppingly larger as it goes toward the front edge.

Such constructed vehicle wheel raw material 1 is placed on the mandrel 12. In this case, the dilating angles β_1, β_2 and β_3 of the rim molding surface 123 of this mandrel 12 are smaller than the dilating angles α_1 α_2 and α_3 of the reversed side cylindrical raw material 3. Thus, between the reversed side cylindrical raw material 3 and the rim molding surface 123 of this mandrel 12, a gap S is formed which becomes gradually dilated as it goes toward the front edge.

As the spinning molding raw material of claim 10 is construction in the manner as described above, when the cylindrical raw material to be molded is drawn along the molding surface of the mandrel, such cylindrical raw material to be molded as mentioned above easily gets used to the mandrel along its molding surface which is gradually steppingly dilated.

Therefore, if this spinning molding process is used, the cylindrical raw material to be molded can easily be spinning molded into a predetermined shape (for example, vehicle wheel) which is gradually steppingly dilated along the molding mandrel.

If the dilating angle of the cylindrical raw material to be molded is steppingly increased as in the case with the spinning molding raw material of claim 11, the working per formance of the spinning molding work is by far improved.

Furthermore, if the dilating angle of the cylindrical raw material to be molded is formed larger

than the dilating angle of the molding surface (of the molding mandrel) as in the spinning molding raw material of claim 12, the working performance of the spinning molding work is by far improved.

Next, the embodiment of claims 13 and 14 will be described with reference to Figs. 7 through 12.

In Figs. 7 through 12, the numeral 1 denotes a vehicle wheel raw material (corresponding to the "spinning molding cylindrical raw material" of claims 13 and 14), which is integrally formed by forging. This vehicle wheel raw material 1, as will be described hereinafter, is molded into a vehicle wheel by spinning molding. Reference character D denotes a disk portion of the wheel raw material 1, and the numerals 61, 61, ••• denote spoke portions thereof. The spoke portions 61, 61, ••• radially extends from said disk portion D, and connected to the edge of a rim portion (corresponding to the "cylindrical body" of claims 13 and 14). The numeral 111 denotes a axle hole of the disk portion D.

Next, the numerals 621, 621, ••• denote grooves which are formed on the inner peripheral surface of the rim portion 62 by warping the rim portion 62 outward. Each of the grooves 621 extends in the width direction (of the rim portion 62) from the connecting portion of the spoke portion 61. Also, the numerals 611, 611 denote auxiliary grooves, which are formed on the rear sides of the spoke portions 61, 61, •••. This auxiliary groove 611 is connected to the groove 621 of the rim portion 62, respectively. In the state of the wheel raw material 1, window portions 63, 63, ••• are not yet penetrated.

Next, in Figs. 11 and 12, there will be described a spinning molding process in which the wheel raw material 1 is used.

In Fig. 11, the numeral 12 denotes a spinning molding mandrel which is rotatable about the axis 127. The wheel raw material 1 is engaged with the outer periphery of this mandrel 12 which is clamped by a tail stock 11. At this time, gaps S, S, ••• generally corresponding to the depth of a groove portion 621 are created between the bottom surface of the groove portion 621 in the wheel raw material 1 and the molding surface of the mandrel 12. These gaps S, S, ••• extend in the width direction of the rim portion 62.

In this state, while rotating the mandrel 12 about the axis 127, the pressing device 2 is abutted against the generally intermediate portion of the rim portion 62 and the rim portion 62 is drawn outside by this pressing device 2 along the direction as shown by the arrow from this intermediate portion. By this, a vehicle wheel W (the state shown by the imaginary lines of Fig. 11) is spinning molded. At this time, the recess portion 7 is formed in the root (the connecting portion to the spoke portion 61) of the rim portion 62.

As is shown in Fig. 12, a final product (shown by the solid line) can be obtained by cutting the vehicle wheel (see the imaginary line of the figure) which was subjected to the spinning molding. At this time, the window portions 63, 63, 63, ••• are penetrated.

As the spinning molding cylindrical raw material is constructed in the manner as described above, if this cylindrical raw material is fixed to the mandrel and drawn along the molding surface of the mandrel while partly pressing the outer peripheral surface of the cylindrical body in the cylindrical raw material with the pressing device by rotating the mandrel, the recess portion can be intermittently formed in the inner peripheral surface of the cylindrical body. As a consequence, the cylindrical body can be made light in weight.

Also, as the spinning molding cylindrical raw material of claim 14 is constructed in the manner as described above, the recess portion can be formed by spinning molding.

Accordingly, if the spinning molding process of this cylindrical body is used, contrary to the prior art, the recess portion can be formed in the inner peripheral surface of the root and truck portion (connecting portion between the rim portion of the vehicle wheel and the spoke portion) of the cylindrical body which is spinning molded. Thus, the cylindrical body can be made light in weight.

Next, the embodiment of claims 15 through 18 will be described with reference to Fig. 13.

In Fig. 13, reference character A denotes a spinning molding apparatus, and the numeral 125 denotes a rotational shaft of the spinning molding apparatus A. This rotational shaft 125 is rotatable about the axis thereof. The numeral 12 denotes a mandrel which is removably engaged with the outer periphery of the rotational shaft 125. The peripheral surface of this mandrel 12 forms a die portion 126 for spinning molding a vehicle wheel W. The numeral 1 denotes a cast vehicle wheel wheel raw material (corresponding to the "cast molding raw material to be molded" of the present invention), and the components thereof are Si; 5.0~ 9.0%, Mg; 0.15~ 0.4%, Ti;≤ 0.2%, Fe;≤ 0.3%, Al: remainder, or Si≤ 0.2%, Mg:2.5~ 5.5%, Ti≤ 0.2%, Mn≤ 0.6%, Al: remainder. It may cast from an AC4 material. This vehicle wheel raw material 1 is disposed on one side of the mandrel and clamped by the tail stock 11. Owing to the foregoing, in accordance with the rotation of the mandrel 12, the vehicle wheel raw material 1 is rotated in the same direction. This vehicle wheel raw material 1 is made by casting and comprises a disk portion D which is sandwiched between the mandrel 12 and the tail stock 11 and a rim raw material 11 (see the imaginary line of the figure). If the rim raw material 3 is

drawn in the direction as shown by the arrow with the pressing spatula 2 while rotating the mandrel 12, the rim 31 is spinning molded. The numeral 8 denotes a burner (corresponding to the "heating means" of the present invention) and is adapted to heat the rim raw material 3. This burner 8 is disposed on the pressing spatula 2 and moved in accordance with the movement of the pressing spatula 2. Owing to the foregoing, the working portion of the pressing spatula 2 can be partly heated. When the rim 31 is spinning molded, the raw material 3 is preferably heated to 230~ 400°C by a burner 8. The reason is that if the heating temperature is less than 230°C, moldability becomes poor and cracks are occurred, while if the heating temperature is 400°C or more, the disk portion (vehicle wheel raw material 4) D becomes too soft and is easily deformed. Also, in order to set the rim raw material 3 within the temperature range (230~ 400°C), the temperature of the molding portion of the rim raw material 3 is measured by an infrared thermometer and the heating power of the gas burner 8 is adjusted in accordance with the feed back system. Upon start of the rotation of the mandrel 12, the burner 8 is ignited and the burner is extinguished upon stop of the rotation.

In order to spinning molding the vehicle wheel by such spinning molding apparatus S, first, the cast vehicle wheel raw material 1 is placed on the mandrel 12. And after clamped by the tail stock 11, the mandrel 12 is rotated at approximately 300RPM. At this time, the burner 8 is ignited simultaneously and starts heating the rim raw material 3. And when the temperature of the rim raw material has reached to a predetermined temperature (230~ 400°C), this rim raw material 3 is drawn in the direction as shown by the arrow by the pressing spatula 2 to obtain the vehicle wheel W. After molding the vehicle wheel W, the mandrel 12 is stopped rotating. At this time, the gas burner 8 is extinguished simultaneously.

In addition to heat the cast molding raw material to be molded, the mandrel and/or the pressing spatula may be heated.

As the spinning molding apparatus of claim 15 is constructed in the manner as described above, the spinning molding can be carried out while maintaining the good ductility of the cast raw material to be molded. As a result, the cast raw material to be molded can be drawn along the mandrel with ease. Therefore, even when the cast raw material to be molded is rapidly machined into a complicated shape, unreasonableness is not occurred to the cast raw material to be molded. As a result, cracks are hardly created in such raw material.

It is desirable that the raw material to be molded can be heated to 230~ 400°C by the heating means. The reason is that if the heating temperature is less than 230°C, the moldability becomes poor and cracks are created. On the other hand, if the heating temperature is 400°C or more, the raw material to be molded becomes too soft and the mandrel fixing portion in the raw material to be molded is easily deformed.

Accordingly, if the spinning molding apparatus according to the present invention is used, the cast raw material to be molded can be rapidly machined into a complicated shape with ease.

Next, the embodiment of claim 19 will be described with reference to Figs. 14 through 19.

In Figs. 14 through 19, the numeral 12 denotes a spinning molding mandrel, and 11 denotes a tail stock. The axis of the mandrel 12 is aligned with the axis of the tail stock 11. The numeral 119 denotes a shaft hole of the mandrel 12 and 125 denotes a first operation rod which is reciprocally movably disposed in the shaft hole 119. This first operation rod 125 is provided with an extruding plate 128 fixed to a front end thereof. This extruding plate 128 is used for removing the vehicle wheel W after molded. Similarly, the numeral 91 denotes a second operation rod, which is reciprocally movably disposed on a substrate F of the spinning molding apparatus. The front end of this second operation rod 91 is fixed to the tail stock 11 and used to reciprocally move the tail stock 11 along the axis. The numeral 112 denotes a retaining hole (corresponding to the "retaining portion" of the present invention), which is formed on the edge of the tail stock 11. Likewise, the numeral 92 denotes a retaining rod which is reciprocally movably disposed on the substrate F. By reciprocal movement of the retaining rod 92, it can be engaged with and disengaged from the retaining hole 112 of the tail stock 11.

Next, there will be described a method for using the spinning molding apparatus.

In Fig. 14, the mandrel 12 is stopped in a suitable position. The tail stock 11 is now in its retreated position on the side of the substrate F by means of manipulation of the second operation rod 91. At this time, the retaining rod 92 is engaged in the retaining hole 112 of the tail stock 11. The numeral 1 denotes a vehicle wheel raw material (corresponding to the "raw material to be molded" of claim 19) clamped by a chuck member C and disposed between the mandrel 12 and the tail stock 11. The chuck member C is adapted to clamp the vehicle wheel raw material 1.

Next, as is shown in Fig. 15, the second operation rod 91 is manipulated to extrude the tail stock 11 and the first operating rod 125 is manipulated to extrude the extruding plate 128 so that the wheel member 1 is held between the tail stock 11 and the extruding plate 128. At this time, simultaneous with

the extrusion of the tail stock 11, the retaining rod is stretched and the retaining state in the retaining hole 112 is maintained.

Next, as is shown in Fig. 16, while holding the wheel raw material 1 between the extruding plate 128 and the tail stock 11, the tail stock 11 is further extruded and the wheel raw material 1 is intimately contacted with the mandrel 12. At this time, the retaining rod 92 is retreated and disengaged from the retaining hole 112 of the tail stock 11. And in this state, while rotating the mandrel 12 about the axis, the wheel raw material 1 is drawn along the molding surface (of the mandrel 12) by the pressing member 2, there by to realize the spinning molding of the vehicle wheel W (see Fig. 17).

Next, as is shown in Fig. 18, while holding the vehicle wheel S by the extruding plate 128 and the tail stock 11, the extruding plate 128 is extruded and the vehicle wheel W is removed from the mandrel 12. At this time, simultaneous with the retreatment of the tail stock 11, the retaining rod 92 is stretched and engaged in the retaining hole 112. By this, a right position of the tail stock 11 with respect to the stopped state of the mandrel 12 can be obtained.

Next, as is shown in Fig. 19, after the vehicle wheel W is held between the chuck members d and d, the second opera tion rod 91 is manipulated to retreat the tail stock 11 and the first operating rod 125 is manipulated to retreat the extruding plate 128 in order to release the vehicle wheel W from the tail stock 11 and extruding plate 128. At this time, the retaining rod 92 is also retreated in accordance with the retreatment of the tail stock 11 but its retaining state in the retaining hole 112 is maintained. Thus, the right position of the tail stock 11 with respect to the stopped state of the mandrel 12 is still maintained.

In this embodiment, there has been described a case where a vehicle wheel is molded. However, it goes without saying that the present invention is likewise applicable to other spinning molding apparatus.

As the spinning apparatus of claim 19 is constructed in the manner as described in the above, if it is designed such that the corresponding position of the tail stock with respect to the stopped position of the mandrel is established beforehand and in such established position, the tail stock is separated from the mandrel and at the same time the tail stock is retained by the retaining rod, the tail stock can secure a right position with respect to this mandrel as long as the mandrel is being stopped in the above-mentioned state.

Accordingly, if this spinning molding apparatus is used, the tail stock can be positioned with respect to the mandrel with ease. As a consequence, the mounting work of the raw material to be molded in the spinning molding can be extensively simplified compared with the prior art.

Next, the embodiment of claim 20 will be described with reference to Figs. 20 through 22.

In Fig. 20, the numeral 12 denotes a spinning molding mandrel which is rotatable about the axis 127 thereof. The numeral 1 denotes a wheel raw material (corresponding to the "raw material to be molded" of claim 20) and is clamped by the tail stock 11 in the state where the wheel raw material 1 is engaged with the outer periphery of the mandrel 12. This wheel raw material 1 comprises a disk portion D, a spoke portion 15, and a rim portion 3. Next, the numeral 126 denotes a molding surface of the mandrel 12 which is formed on the peripheral surface of the mandrel 12. This molding surface 126 is adapted to mold the rim portion 31 of the vehicle wheel W. Also, particularly, the numeral 129 denotes a rim flange molding portion which is formed on both edges of the mandrel 12. This rim flange molding portion 129 forms a plane generally vertical to the axis 127 of the mandrel 12. This rim flange molding portion 129, as shown in Fig. 21, is provided with a displaying irregularity portion M formed thereon. This displaying irregularity portion M is formed in irregularity in accordance with the shapes of letters, marks, etc. They have shapes corresponding to, for example, size of a product, manufacturing date, etc.

In the foregoing state, while rotating the mandrel 12 about the axis 127, the pressing device 2 is contacted with the rim raw material portion 3 and the rim raw material portion 3 is drawn outward (arrow direction) by this pressing device 2. As a result, there can be spinning molded a vehicle wheel (in the state shown by the imaginary line of Fig. 20) W. At this time, the size of a product, manufacturing date, etc. can be applied to the rim flange portion 311 of the vehicle wheel W simultaneously (see Fig. 22).

As the spinning molding apparatus of claim 20 is constructed in the manner as described in the foregoing, a suitable displaying means can be applied to the molded product while molding the raw material to be molded along the molding surface of the mandrel.

Accordingly, if this spinning molding apparatus is used, there is no more required to apply a suitable displaying means by stamping, etc., after spinning molding as in the prior art. As a consequence, the work for applying such suitable displaying means to the spinning molded product can be made only by one process. As a result, the working efficiency of the spinning molding work is improved.

While particular embodiments of the present invention have been shown in the drawings and described above in great detail, it will be apparent

that many changes and modifications can be made within the spirit of the invention. In consideration thereof, it should be understood that the preferred embodiments of the present invention disclosed herein are intended to be illustrative only and not intended to limit the scope of the invention.

Claims

1. A process for manufacturing a vehicle wheel comprising the steps of:
preparing a wheel raw material in which a rim raw material is integrally formed at a peripheral edge of a disk member;
forming a rim portion by spinning said rim raw material while rotating said wheel material about the axis of said disk member; and
thereafter heat processing such spin molded raw material and then cut machining the same;
characterized in that said process further comprises the step of:
forming the thickness of only both edges of said rim portion greater than the finish dimension.

2. A process for manufacturing a vehicle wheel as claimed in claim 1, wherein said both edges of said rim portion are a rim hump portion and a rim flange portion.

3. A spin molding apparatus of a vehicle wheel comprising:
a molding die, on the periphery of which a wheel raw material is place; and
a rotary pressing device separately prepared and adapted to draw said wheel raw material along said molding die while rotating said wheel raw material together with said molding die;
characterized in that a drop center molding portion in said molding die is cut in the vertical direction through the axis thereof and an auxiliary molding die is disposed in the cutting plane.

4. A spinning molding material containing Si: 3~ 6 weight percent and Mg: 0.2~ 0.5 weight percent.

5. A spinning molding process comprising the steps of:
integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped; and
spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape;
characterized in that said process further comprises the step of:
forming a peripheral portion of said cylindrical raw material on the highest projecting portion of a molding surface in said molding mandrel when said cylindrical raw material is mounted on said molding mandrel.

6. A spinning molding process comprising the steps of:
integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped; and
spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape;
characterized in that said process further comprises the step of:
forming the thickness of the peripheral edge portion in said cylindrical raw material to be molded greater than that of the remainder.

7. A spinning molding process comprising the steps of:
integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped; and
spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape;
characterized in that said process further comprises the step of:
forming a peripheral groove-like twisted portion on an outer wall surface of a generally connecting portion between said cylindrical raw material to be molded and said plate portion to be clamped.

8. A spinning molding process comprising the steps of:
integrally forming a cylindrical raw material to be molded with the peripheral edge of a plate portion to be clamped; and
spinning molding said cylindrical raw material which is in engagement with the outer periphery of a molding mandrel into a predetermined shape;
characterized in that said process further comprises the step of:
forming a gap between said cylindrical raw material to be molded and said molding mandrel when said cylindrical raw material to be molded is mounted on said molding mandrel, said gap being formed such that it becomes gradually greater in width as it goes toward the peripheral edge thereof.

9. A spinning molding process as claimed in claim 8, wherein an angle formed between said cylindrical raw material to be molded and the molding surface of said molding mandrel is about 5~ 30 degrees.

10. A spinning molding material comprising:
a plate portion to be clamped;
a cylindrical raw material to be molded integrally formed with the peripheral edge of said plate portion to be clamped; and
a molding mandrel with the outer periphery of which said raw material to be molded is engaged when said raw material to be molded is spinning molded into a predetermined shape;
characterized in that said cylindrical molding ma-

terial to be molded is gradually dilated as it goes toward the peripheral edge thereof and the dilating angle is steppingly changed as it goes toward the peripheral edge thereof.

11. A spinning molding material as claimed in claim 10, wherein said dilating angle of said cylindrical raw material to be molded becomes steppingly greater.

12. A spinning molding material as claimed in claim 10 or claim 11, wherein said dilating angle of said raw material to be molded is greater than the dilating angle of said molding surface.

13. A spinning molding cylindrical raw material having a groove portion formed on the inner peripheral surface of a cylindrical body along the width direction thereof.

14. A spinning molding process of a cylindrical body com prising the steps of:
fixing a spinning molding cylindrical raw material having a groove portion formed on the inner peripheral surface of said cylindrical body along the width direction thereof to the outer surface of a mandrel;
rotating said cylindrical raw material by rotating said mandrel about the axis thereof; and
drawing said cylindrical body along a molding surface of said mandrel while partly pressing the peripheral surface of said cylindrical body with a pressing device.

15. A spinning molding apparatus comprising:
a mandrel on which a cast raw material to be molded is placed;
heating means for heating said cast raw material to be molded which is being rotated in accordance with rotation of said mandrel; and
a pressing spatula for pressing said rotating cast raw material to be molded so that said cast raw material to be molded is drawn along said mandrel in the meantime;
characterized in that the components of said cast raw material to be molded are as follows;
Si; 5.0~ 9.0%, Mg; 0.15~ 0.4%, Ti≦ 0.2%, Fe≦ 0.3%, Al: remainder, or
Si≦ 0.2%, Mg; 2.5~ 5.5%, Ti≦ 0.2%, Mn≦ 0.6%, Al: remainder.

16. A spinning molding apparatus as claimed in claim 15, wherein said cast raw material to be molded can be heated to about 230~ 400 °C by said heating means.

17. A spinning molding apparatus of a vehicle wheel comprising:
a mandrel on which a cast raw material to be molded is placed;
heating means for heating said cast raw material to be molded which is being rotated in accordance with rotation of said mandrel; and
a pressing spatula for pressing said rotating cast raw material to be molded so that said cast raw material to be molded is drawn along said mandrel in the meantime;
characterized in that the components of said cast raw material to be molded are as follows;
Si; 5.0~ 9.0%, Mg; 0.15~ 0.4%, Ti≦ 0.2%, Fe≦ 0.3%, Al: remainder, or
Si≦ 0.2%, Mg; 2.5~ 5.5%, Ti≦ 0.2%, Mn≦ 0.6%, Al: remainder.

18. A spinning molding apparatus of a vehicle wheel as claimed in claim 17, wherein said cast raw material to be molded can be heated to about 230~ 400 °C by said heating means.

19. A spinning molding apparatus comprising:
a base;
a molding mandrel and a tail stock arranged on said base such that axes of said mandrel and tail stock are aligned, said mandrel and tail stock being reciprocally movable along said axes and being rotatable about said axes; and
a pressing member for drawing said raw material to be molded clamped by said mandrel and said tail stock along a molding surface of said mandrel into predetermined shape while rotating said mandrel;
characterized in that said spinning molding apparatus further comprises:
a retaining rod reciprocally movably disposed on said base for movement with respect to the tail stock direction; and a retaining portion mounted on said tail stock such that said tail stock can be retained by said retaining portion.

20. A spinning molding apparatus comprising:
a spinning molding mandrel having a raw material to be molded placed thereon; and
a pressing member for pressing said raw material to be molded along a molding surface of said mandrel while rotating said mandrel about the axis thereof, so that said raw material to be molded is molded into a predetermined shape;
characterized in that a displaying irregular portion is formed on said molding surface of said mandrel.

Fig. 1

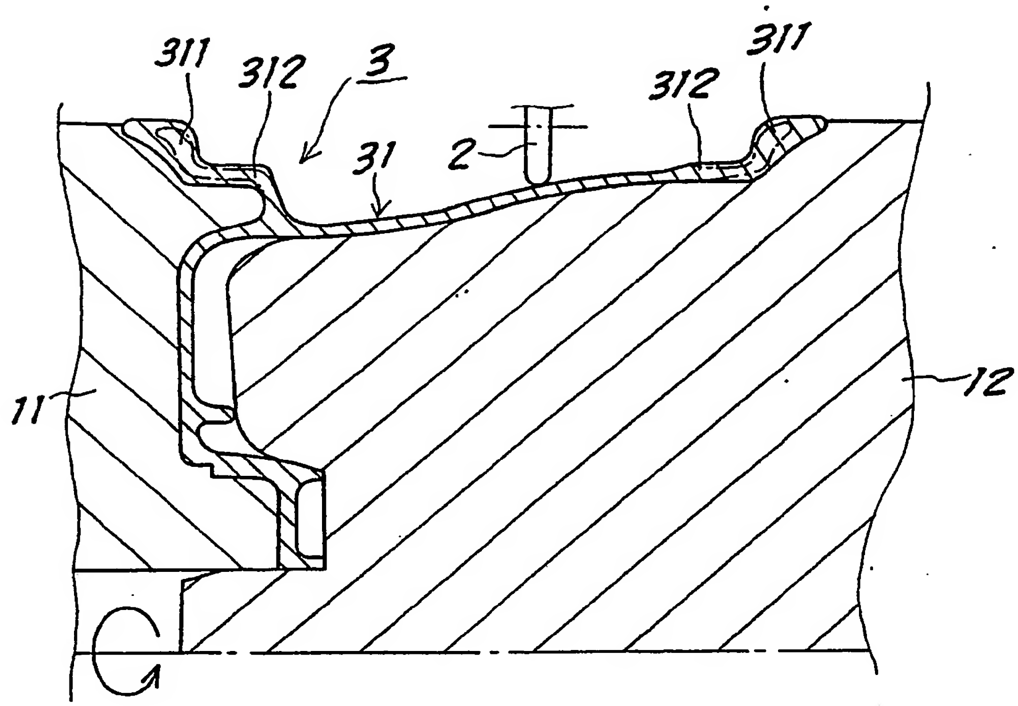


Fig. 2

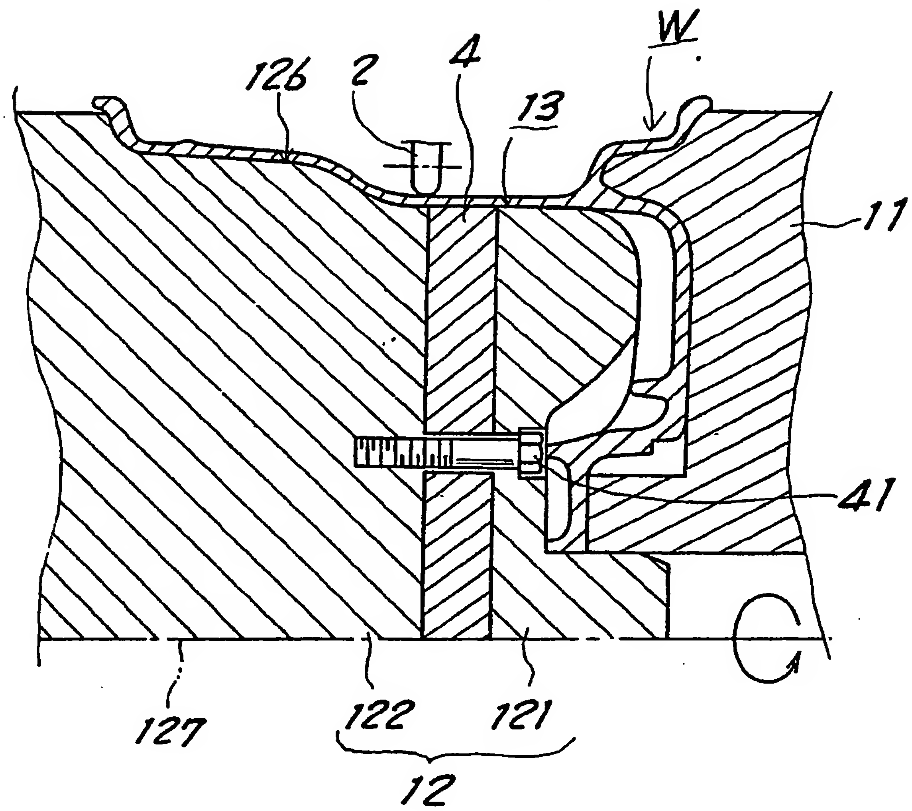
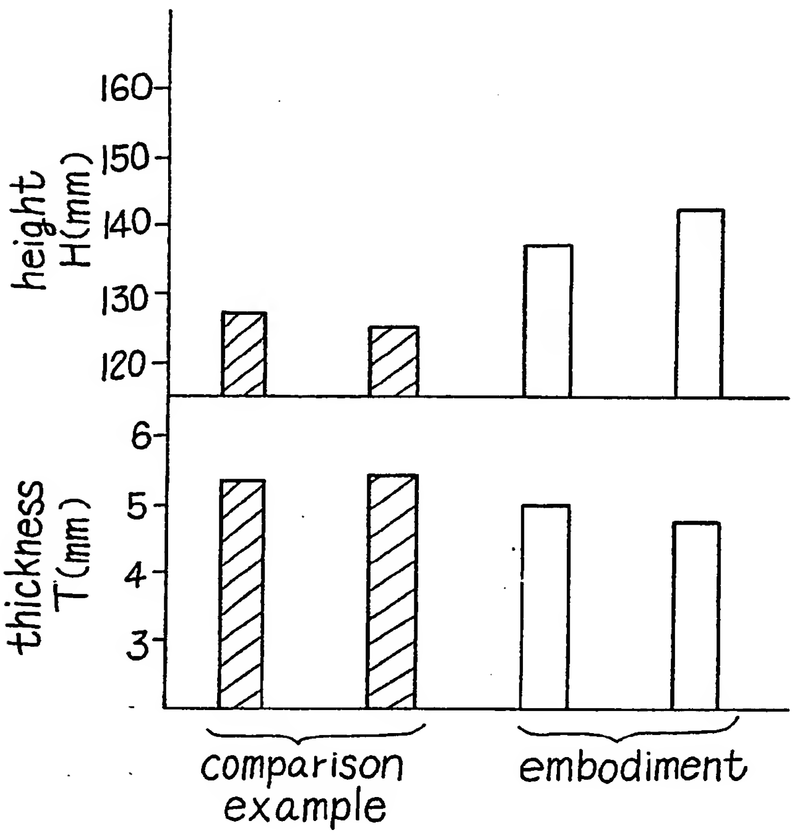
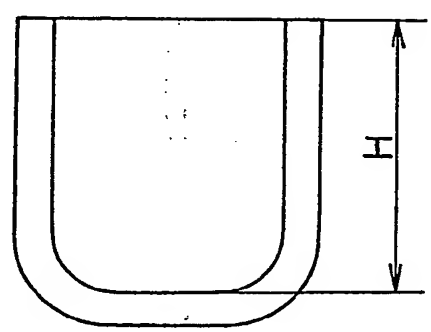


Fig. 3





(test piece)

Fig. 4

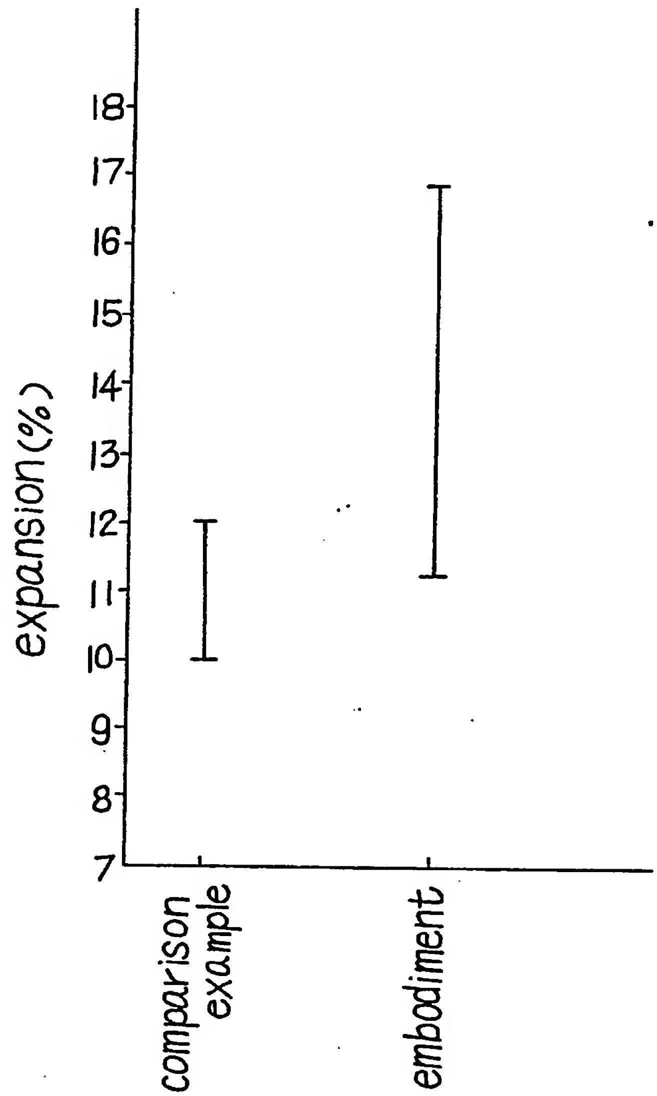

expansion(%)
18
17
16
15
14
13
12
11
10
9
8
7
comparison example
embodiment

Fig. 5

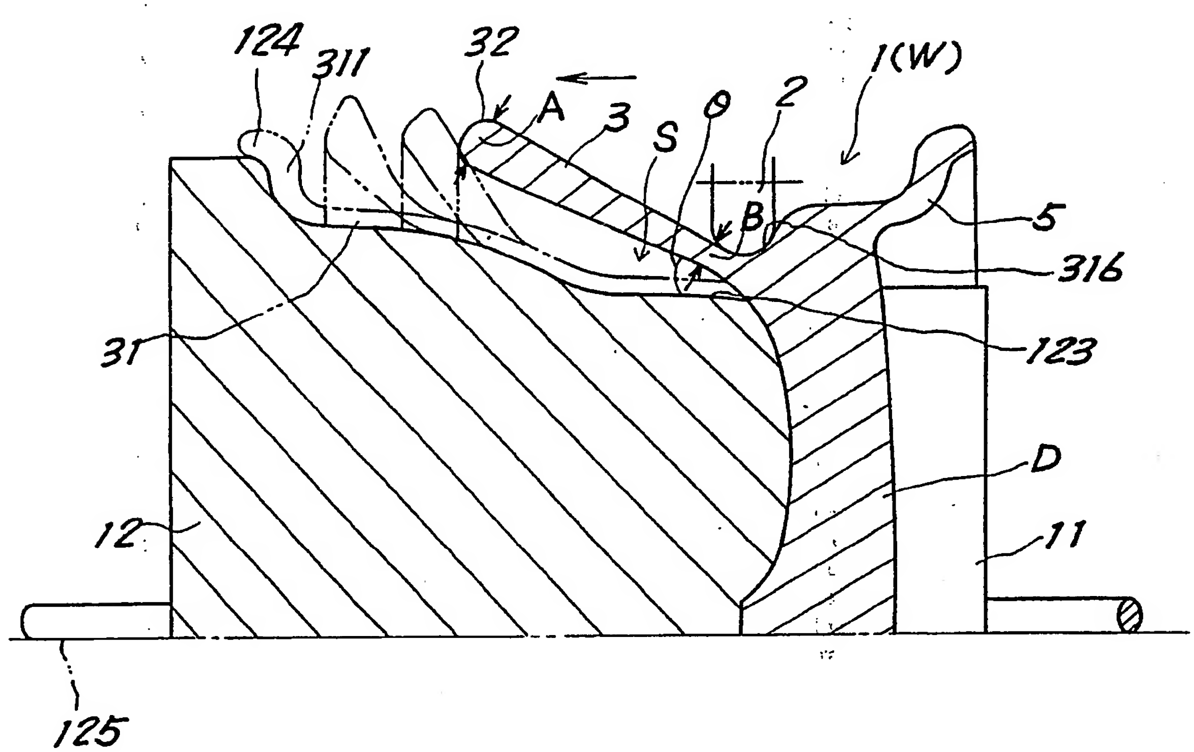


Fig. 6

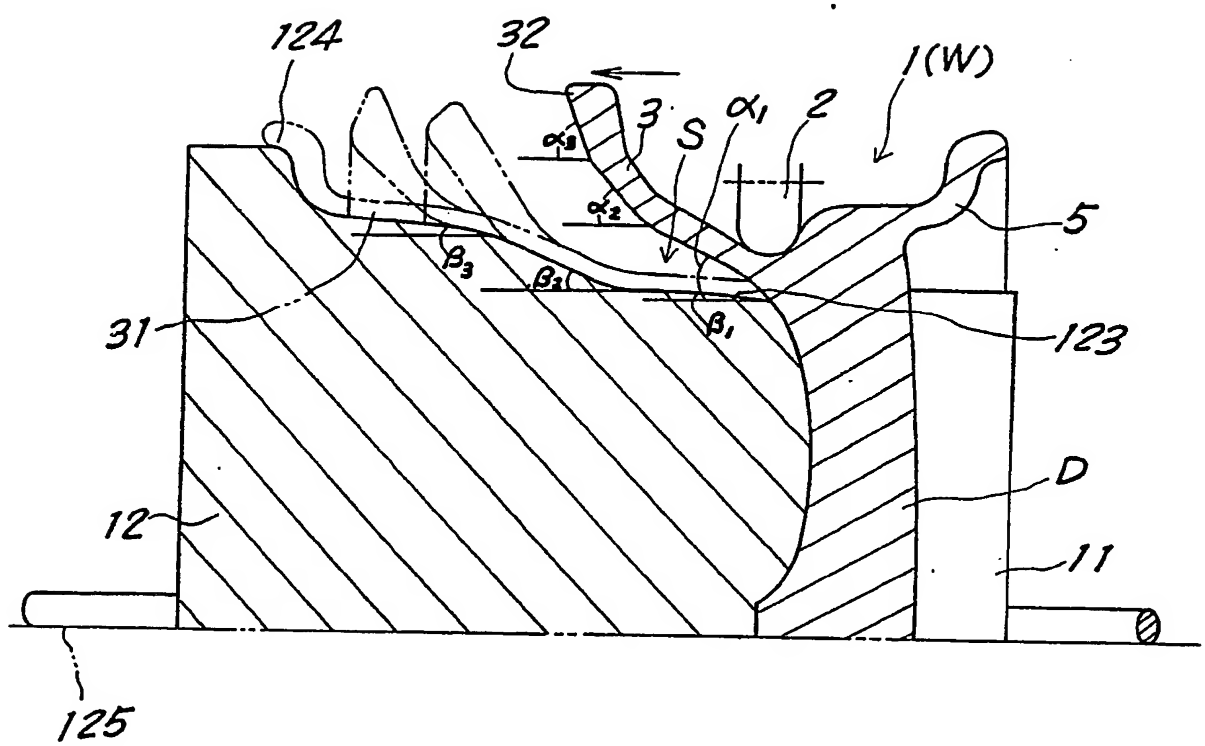

124
32
3
S
α_1
2
1(W)
α_3
α_2
β_3
β_2
β_1
5
31
123
D
12
11
125

Fig. 7

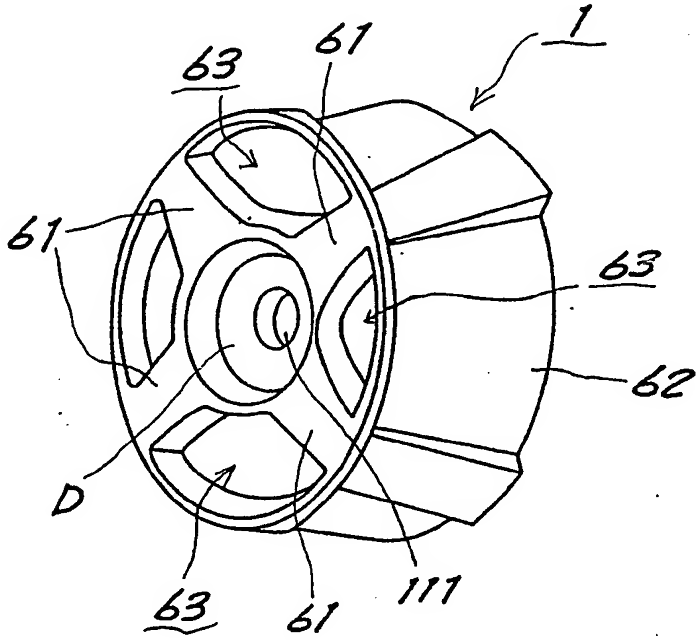


Fig. 8

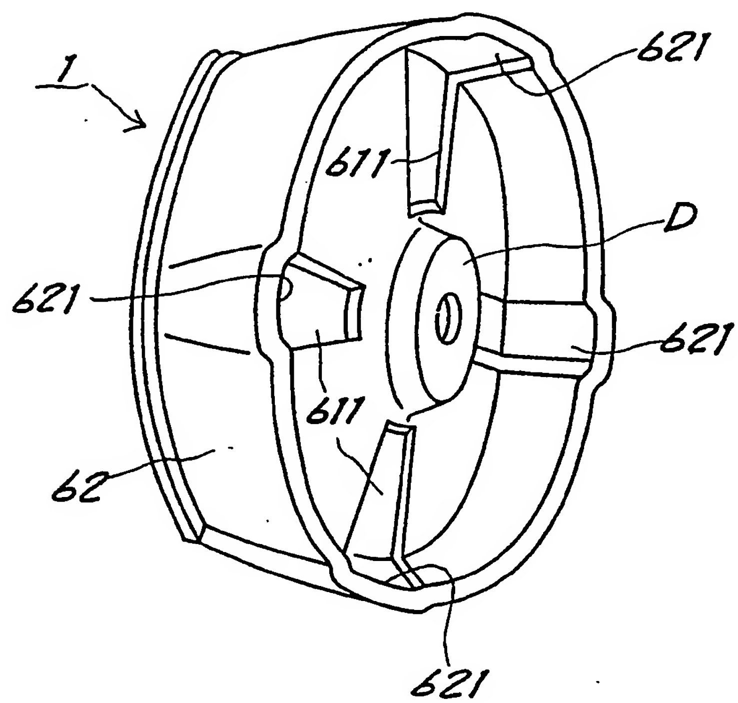


Fig. 9

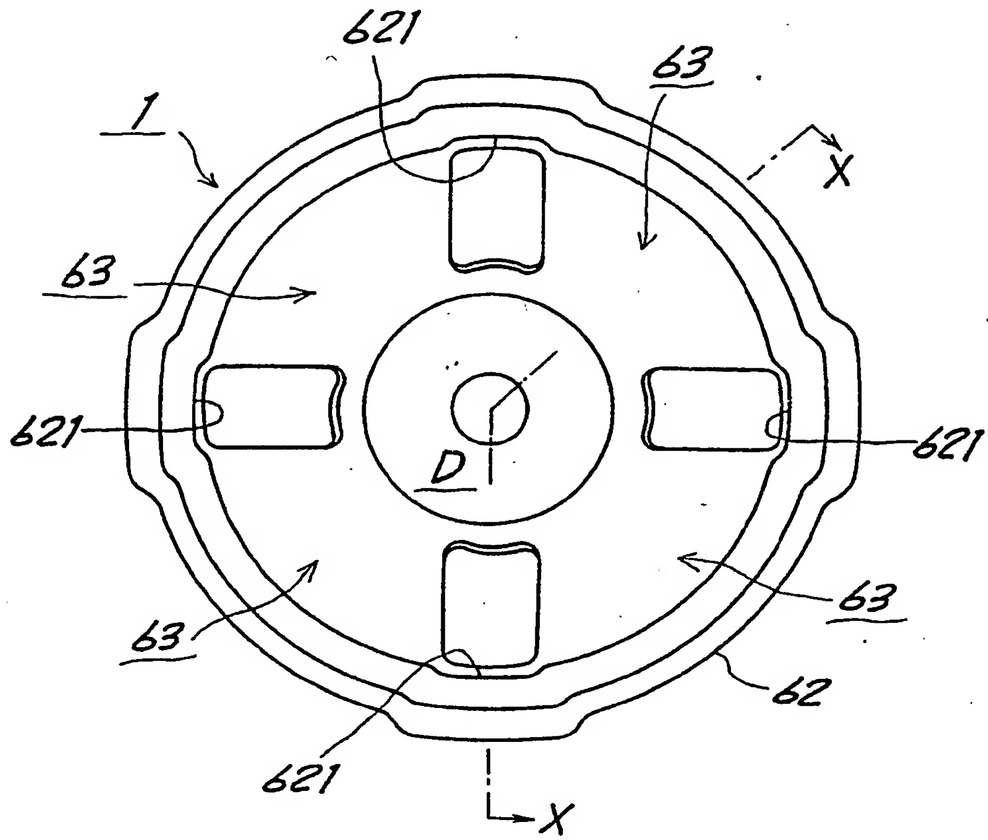


Fig. 10

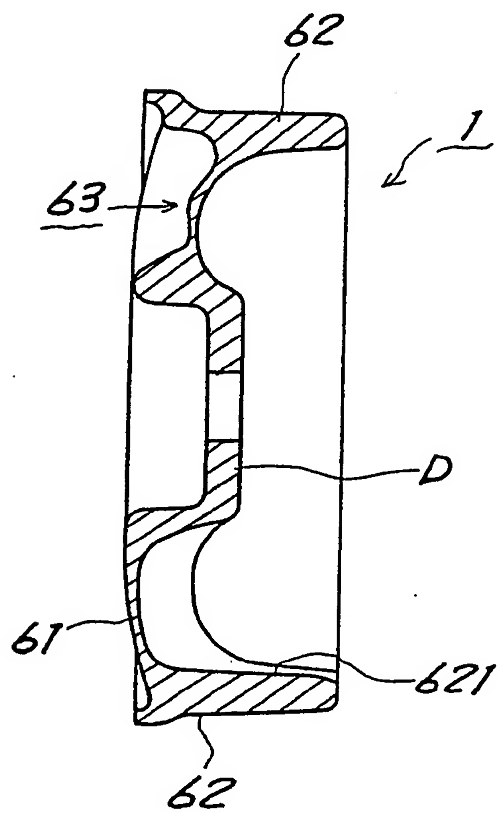


Fig. 11

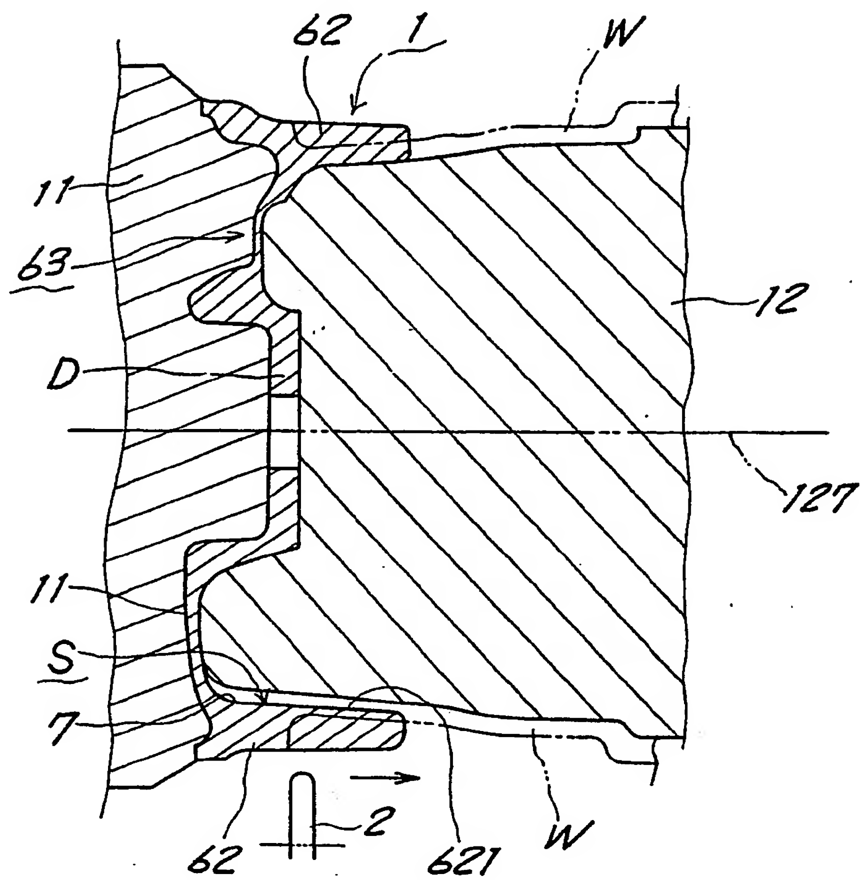


Fig. 12

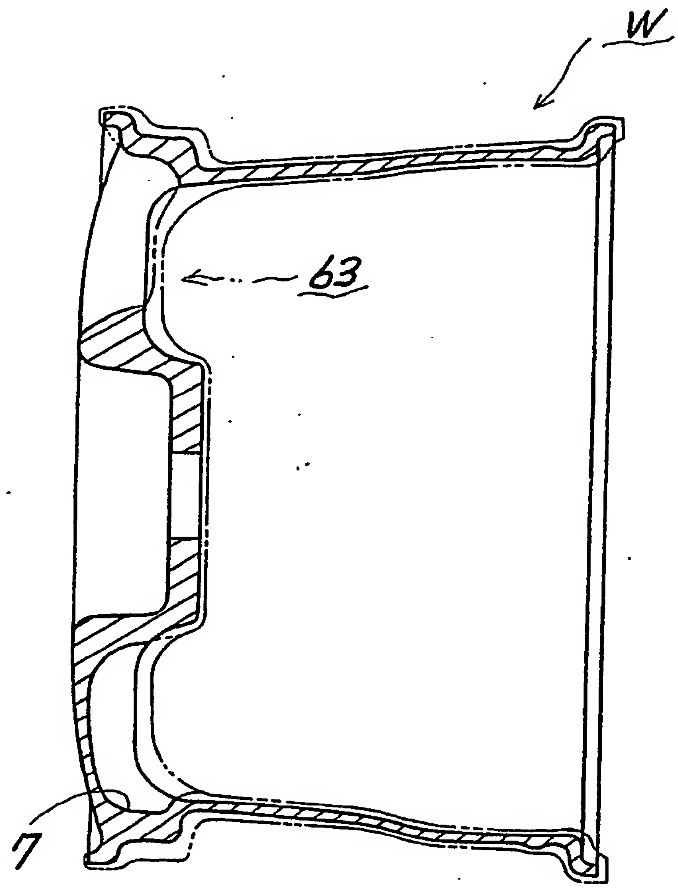


Fig. 13

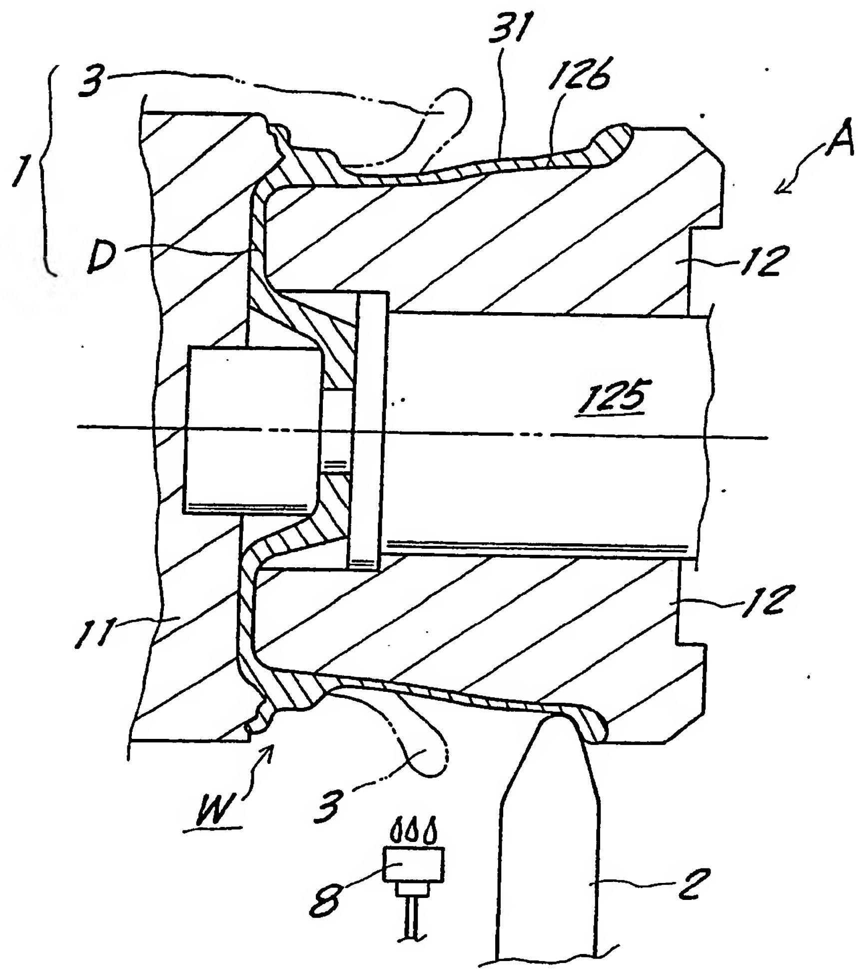


Fig.14

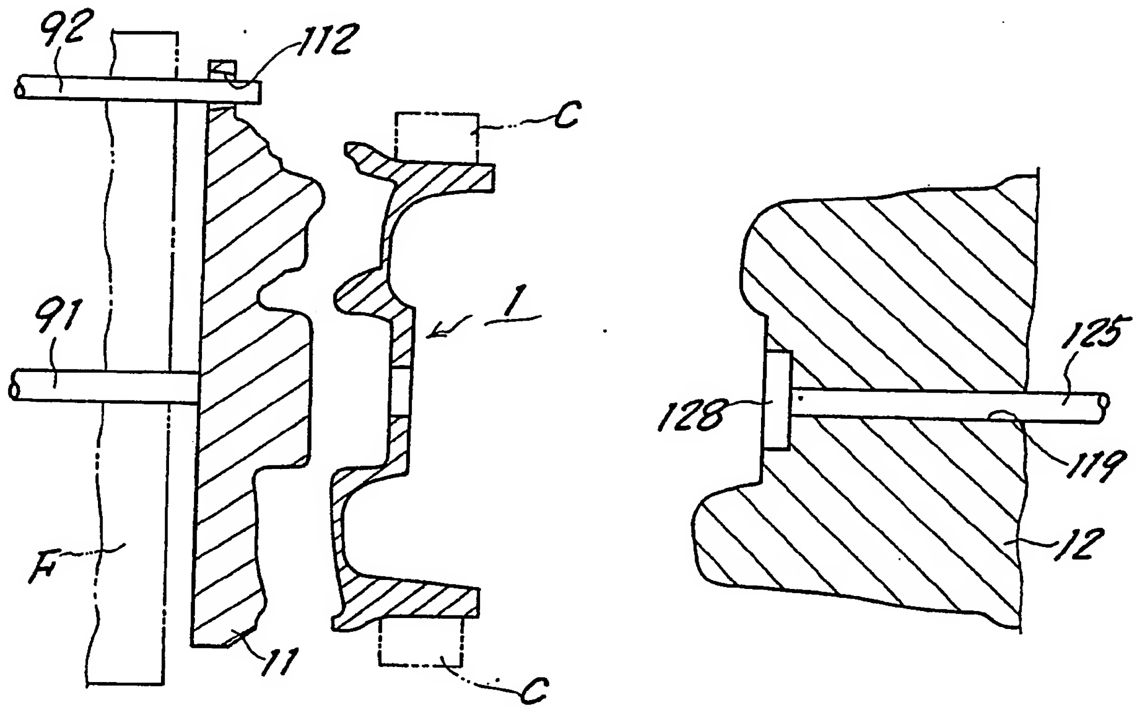


Fig.15

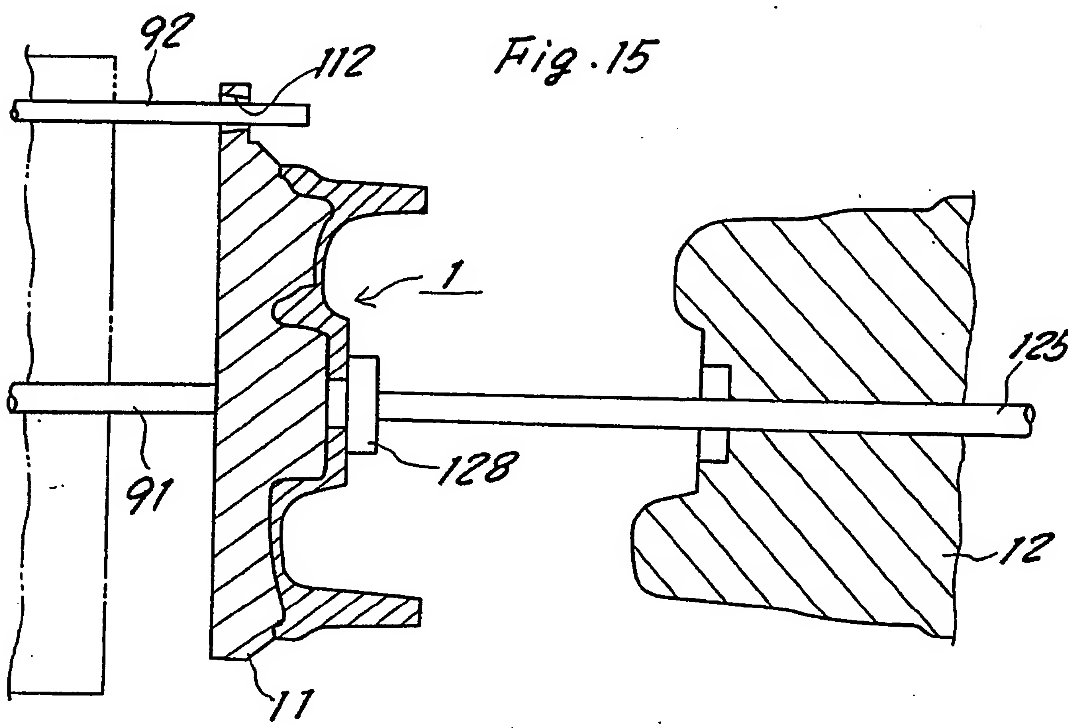


Fig.16

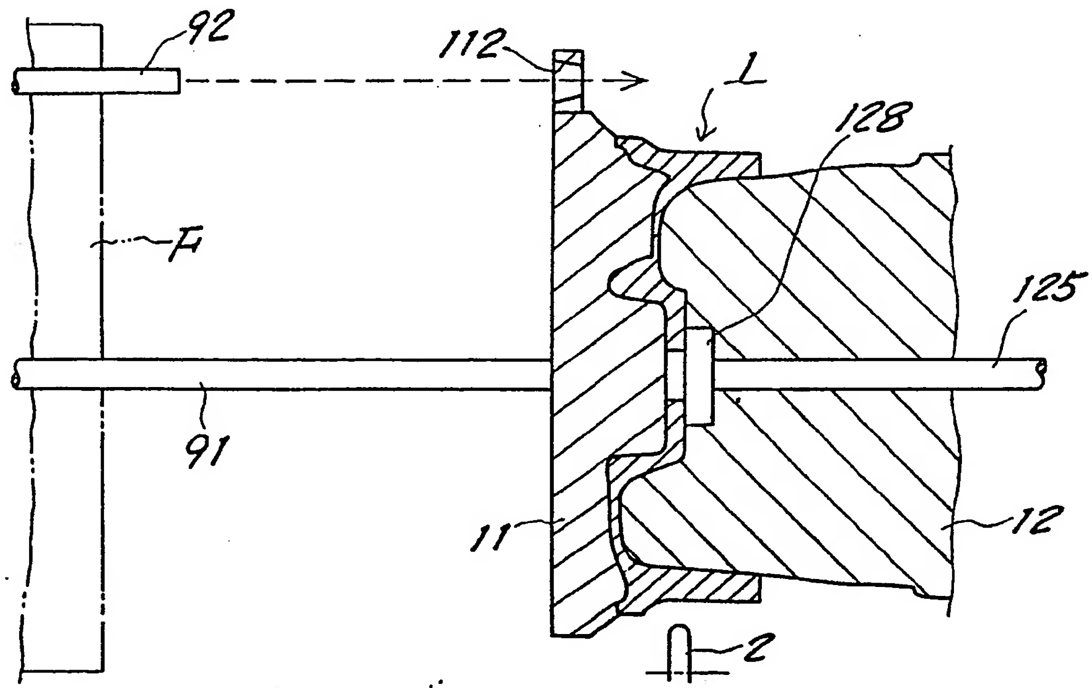


Fig.17

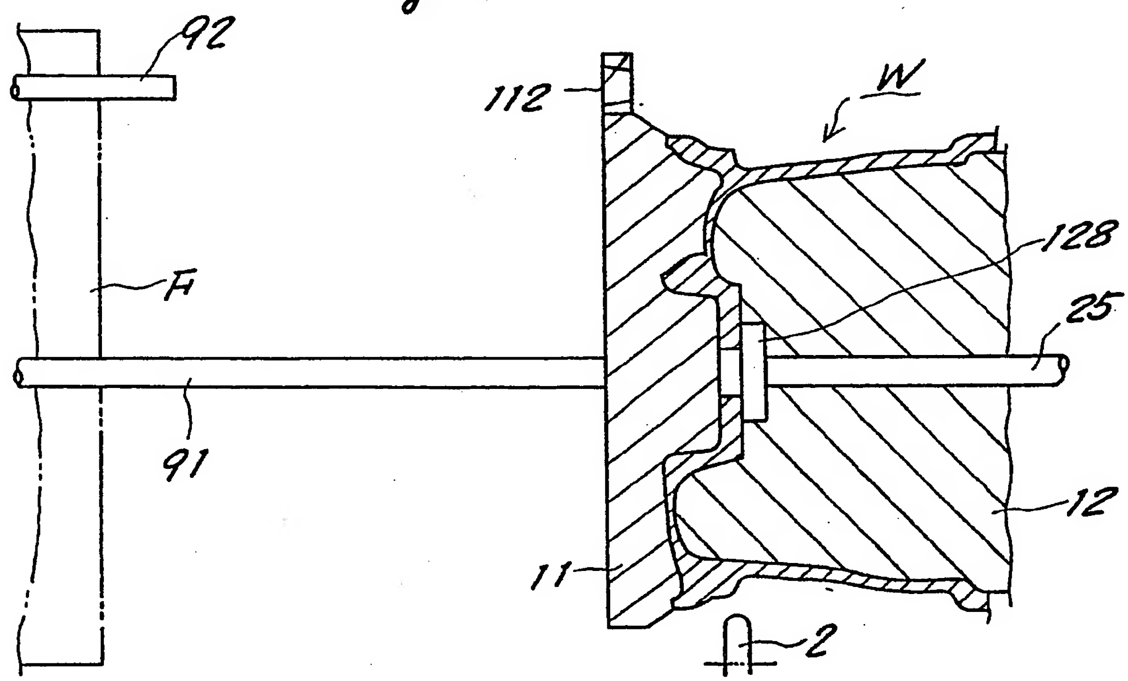


Fig. 18

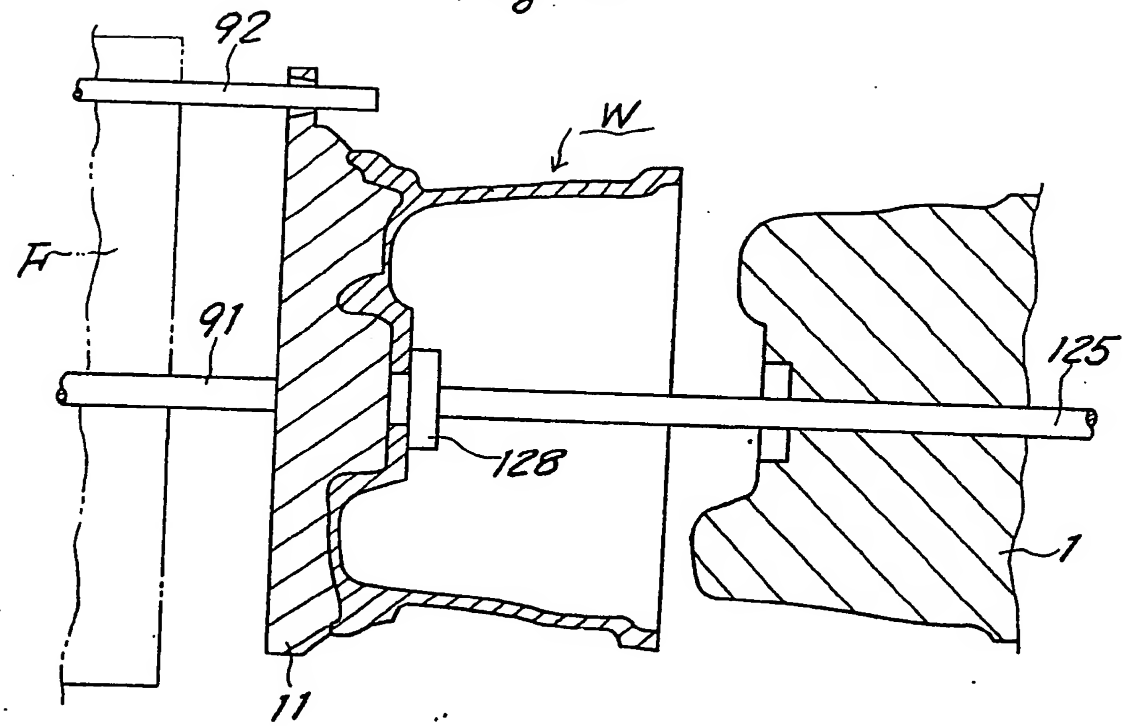


Fig. 19

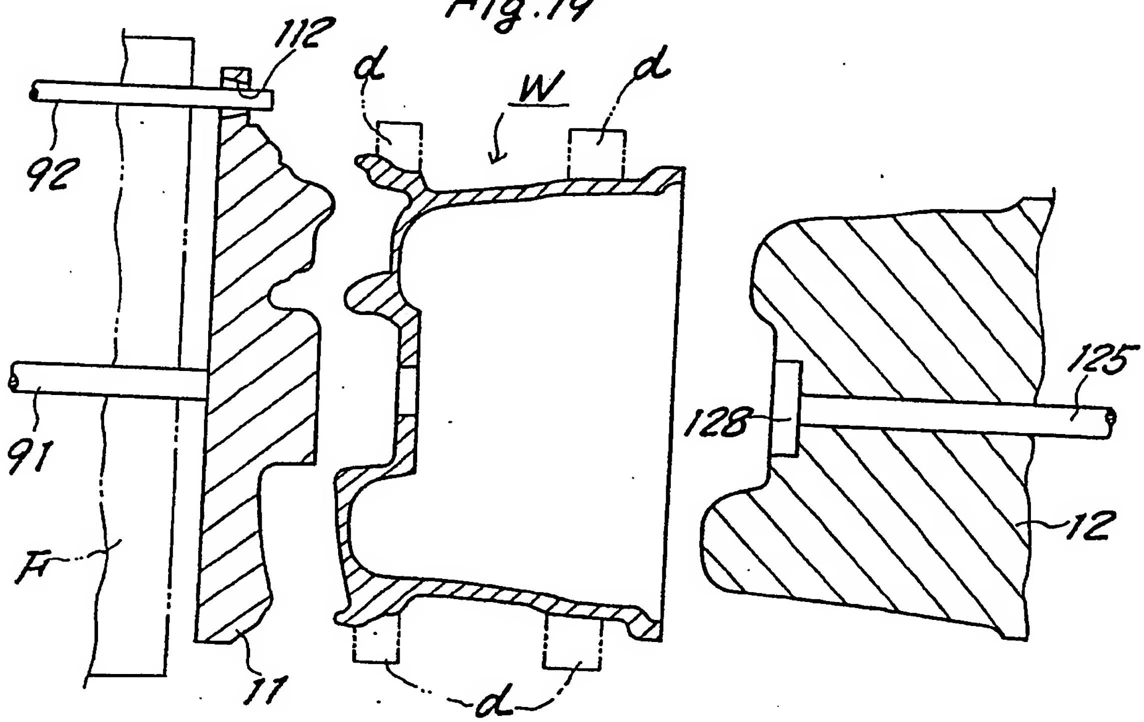


Fig. 20

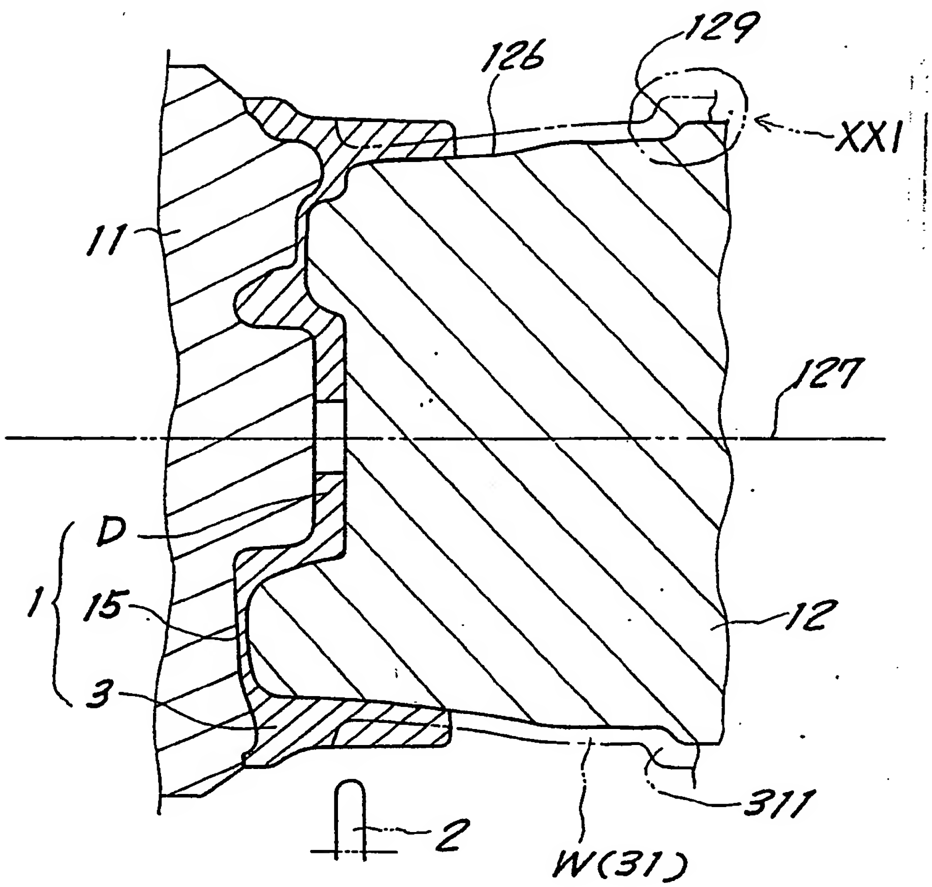


Fig. 21

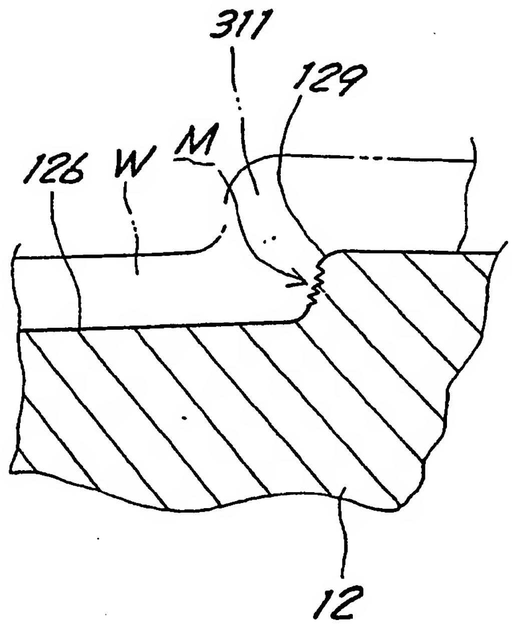


Fig. 22

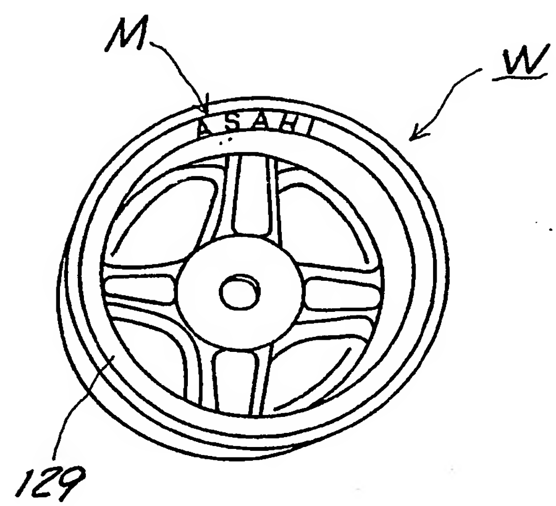


Fig. 23

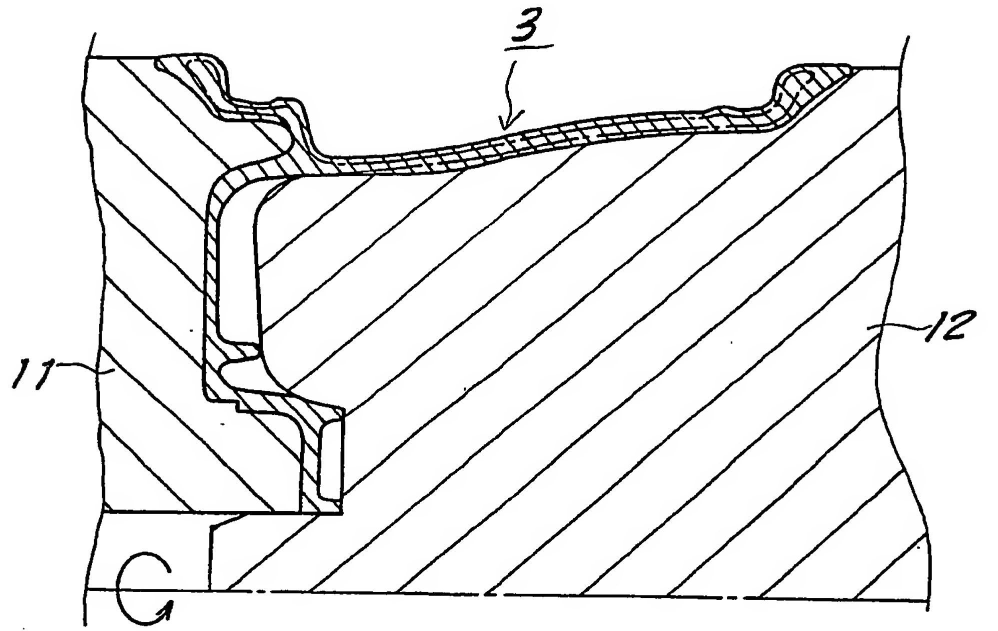


Fig. 24